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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/789,810	02/27/2004	Evgueni Goldberg	CA7031042001	5639
23639 7590 12/26/2006 BINGHAM, MCCUTCHEN LLP THREE EMBARCADERO CENTER 18 FLOOR SAN FRANCISCO, CA 94111-4067			EXAMINER FERNANDEZ RIVAS, OMAR F	
			ART UNIT	PAPER NUMBER
			2129	
SHORTENED STATUTORY PERIOD OF RESPONSE		MAIL DATE	DELIVERY MODE	
3 MONTHS		12/26/2006	PAPER	

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

**Office Action Summary**

Application No.

10/789,810

Applicant(s)

GOLDBERG ET AL.

Examiner

Omar F. Fernández Rivas

Art Unit

2129

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 12 October 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-56 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-56 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date A1, A2, A3.

- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

### **DETAILED ACTION**

1. This Office Action is in response to an AMENDMENT made by the Applicant filed on October 12, 2006.
2. The Office Action of May 4, 2006 is incorporated into this Final Office Action by reference.

#### ***Status of Claims***

3. Claims 1-8, 16, 18, 21, 24-27, 31-34 and 41-44 have been amended. Claims 51-56 have been added. Claims 1-56 are pending on this application.

#### ***Claim Objections***

4. The Applicant's arguments regarding the objection to claims 8, 18, 21 38 and 48 have been fully considered and are persuasive. The objection to the claims has been withdrawn.

#### ***Claim Rejections - 35 USC § 112***

5. In light of the amendments made on claim 25, the rejection under 35 USC 112 has been withdrawn.

#### ***Claim Rejections - 35 USC § 102***

6. In view of new grounds of rejection necessitated by the amendments, the rejection under 35 USC 102 has been withdrawn.
7. The Applicants arguments regarding the rejection under 35 USC 102 have been fully considered but are rendered moot in view of new grounds of rejection necessitated by the amendments.

#### ***Claim Rejections - 35 USC § 103***

Art Unit: 2129

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-7, 9-17, 21, 24,26-29, 31-37, 39-47, 49-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Marques-Silva et al. in view of Bayardo et al. ("GRASP: A Search Algorithm for Propositional Satisfiability", referred to as **Marques-Silva**; "Using CSP Look-Back Techniques to Solve Real-World SAT Instances", referred to as **Bayardo**)

As per claims 1, 31 and 41, Marques-Silva teaches a method of solving satisfiability problems, the method comprising: a) organizing a plurality of clauses in a satisfiability problem as a chronologically ordered structure comprising a top and a bottom, wherein newly deduced conflict clauses are added to the top of the structure; b) selecting a branching variable from a plurality of unassigned variables in the satisfiability problem; c) assigning value 0 or 1 to the selected branching variable; d) marking literals set to 0 e) invoking Boolean Constraint Propagation when the structure comprises one or more unit clauses; 0 repeating (b)-(e) when the structure only comprises one or more non-unit clauses; g) returning a solution if a solution is found (Page 511 Figure 2; the examiner reads the algorithm returns a result either "success" or "failure").

The examiner reads that Figure 2 is code that incorporates all the steps described above (**Marques-Silva**: Section 2.4, page 508).

Marques-Silva does not teach maintaining individual activity counters for variables in the plurality of clauses and in which the branching variable is selected by selecting a clause and an active variable from the clause based upon the activity counter.

Bayardo teaches maintaining individual activity counters for variables in the plurality of clauses and in which the branching variable is selected by selecting a clause and an active variable from the clause based upon the activity counter (**Bayardo**: page 204, C2, L15-31; the score is an activity counter, as understood from paragraph 10 of the present application. The branch variable is selected from the score of the variables in the clause).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating maintaining individual activity counters for variables in the plurality of clauses and in which the branching variable is selected by selecting a clause and an active variable from the clause based upon the activity counter as taught by Bayardo for the purpose of having means to select branch to the variables of the clause that will lead to a satisfactory result to the problem

As per claim 2, 32 and 42, Marques-Silva teaches the structure comprises at least one initial clause (**Marques-Silva**: Section 2.4, page 508; the examiner reads "w" as the initial clause) and at least one conflict clause (**Marques-Silva**: Section 3, page 509; the examiner reads "wc(k)" as the conflict clause).

As per claims 3, 33 and 43, Marques-Silva teaches at least one initial clause is located below the at least one conflict clause in the structure (The initial clause is below the conflict clause because the initial clause is in the database (structure) before a conflict arise).

As per claims 4, 34 and 44, Marques-Silva teaches the branching variable is selected from among a set of unassigned variables in the clause on top of the structure when the top clause is a conflict clause (**Marques-Silva**: Section 2.5, page 509; the examiner reads that the branching variable is selected using the Search function).

As per claims 5, 35 and 45, Marques-Silva does not teach maintaining an activity counter for each unassigned variable.

Bayardo teaches maintaining an activity counter for each unassigned variable (**Bayardo**: page 204, C2, L15-31; the score is an activity counter).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating maintaining an activity counter for each unassigned variable as taught by Bayardo for the purpose of having means to determine the occurrence of a variable in a clause.

As per claims 6, 36 and 46, Marques-Silva teaches the activity counter of an unassigned variable is incremented each time the unassigned variable appears in a clause used when generating a conflict clause (**Marques-Silva**: Section 2.5, page 509;

the examiner reads "d" as being the activity counter because it is incremented every time the search function is called "d+1 ").

As per claims 7, 37 and 47, Marques-Silva does not teach the selected branching variable composes an activity counter, with the highest value.

Bayardo teaches the selected branching variable composes an activity counter, with the highest value (**Bayardo**: page 204, C2, L15-31).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating the selected branching variable composes an activity counter, with the highest value as taught by Bayardo for the purpose of selecting the branch variable based on the variable that occurs more frequently in a clause.

As per claims 8, 38 and 48 Marques-Silva does not teach the activity counters are periodically divided by a constant greater than one.

Bayardo teaches the activity counters are periodically divided by a constant greater than one (**Bayardo**: page 204, C2, L15-31).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating the activity counters are periodically divided by a constant greater than one as taught by Bayardo for the purpose of having means to determine the variables that occur more frequently in a clause.

As per claims 9, 39 and 49, Marques-Silva teaches whether 0 or 1 is assigned to the selected branching variable depends upon costs associated with the positive and negative literals of this variable (Section 2.1, page 507; the examiner reads that the literal can be the occurrence (cost) of a variable or its complement).

As per claim 10, 40 and 50, Marques-Silva teaches the cost of a literal is equal to the total number of conflict clauses containing the literal (Section 2.1, page 507; the examiner reads that the literal can be the occurrence (cost) of a variable).

As per claim 11, Marques-Silva teaches the cost of a literal is equal to the total number of binary clauses containing the literal plus; for each binary clause containing the literal, the total number of binary clauses containing an opposite of the other literal in the binary clause (Section 2.1, page 509; the examiner reads that the literal is the occurrence of a variable or its complement, which is the opposite).

As per claim 12, Marques-Silva teaches if there is at least one unsatisfied conflict clause, the selected branching variable is assigned value 1 if the cost associated with the positive literal of this variable is higher than the cost associated with the negative literal (Fig. 3; the examiner reads that  $X$  can either be set to 1 or zero).

As per claim 13, Marques-Silva teaches if there is at least one unsatisfied conflict clause, the selected branching variable is assigned value 0 if the cost associated with



Art Unit: 2129

the negative literal of this variable is higher than the cost associated with the positive literal (Fig. 3; the examiner reads that "x" can either be set to 1 or zero).

As per claim 14, Marques- Silva teaches if all conflict clauses are satisfied, the selected branching variable is assigned value 0 if the cost associated with the positive literal of this variable is higher than the cost associated with the negative literal (Fig. 3; the examiner reads that "x" can either be set to 1 or zero).

As per claim 15, Marques-Silva teaches if all conflict clauses are satisfied, the selected branching variable is assigned value 1 if the cost associated with the negative literal of this variable is higher than the cost associated with the positive literal (Fig. 3; the examiner reads that "x" can either be set to 1 or zero).

As per claim 16, Marques-Silva teaches maintaining an activity counter for each conflict clause (Fig. 2, page 511; the examiner reads "d" as the counter because it keeps track of the decision level and it is incremented when the clause database is updated) removing one or more conflict clauses from the structure (Fig 2; the examiner reads the code presented in figure 2 has a Erase function).

As per claim 17, Marques-Silva teaches does not teach the activity counter of a conflict clause is incremented each time the conflict clause is used when generating another conflict clause.

Bayardo teaches the activity counter of a conflict clause is incremented each time the conflict clause is used when generating another conflict clause (**Bayardo**; page 204, C2, L15-31; the score will increment each time the variable occurs in a clause).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Bayardo by incorporating the activity counter of a conflict clause is incremented each time the conflict clause is used when generating another conflict clause as taught by Bayardo for the purpose of having means to track of how many times a given variable is present in a conflict clause.

As per claim 18, Marques-Silva teaches at least one of the one or more conflict clauses removed from the structure is near the bottom of the structure (**Marques-Silva**: pages 507 and 508, section 2.2; page 510 Section 3.1; traversing the search tree. The clause is erased at the current decision level which depending on the current decision level could be at the bottom of the structure).

As per claim 19, Marques-Silva teaches at least one removed conflict clause comprises more than eight literals (**Marques-Silva**: page 507, Section 2.1; each clause can contain one or more literals).

As per claim 20, Marques-Silva does not teach at least one removed conflict clause comprises an activity counter with a value less than sixty.

Bayardo teaches at least one removed conflict clause comprises an activity counter with a value less than sixty (**Bayardo**; page 204, C2, L15-31; gathering the variables within 20% of the best score, which could be less than sixty).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating at least one removed conflict clause comprises an activity counter with a value less than sixty as taught by Bayardo for the purpose of maintaining only the variables that occur more frequently in a clause.

As per claim 21, Marques-Silva teaches at least one of the one or more conflict clauses removed from the structure is near the top of the structure (Section 3.1, page 510; the examiner reads that a conflict clause database is augmented with the clause database and the clause is erased at the current decision level which is near the top).

As per claim 22, Marques-Silva teaches at least one removed conflict clause comprises more than forty-two literals (**Marques-Silva**: page 507, Section 2.1; each clause can contain one or more literals).

As per claim 23, Marques-Silva does not teach at least one removed conflict clause comprises an activity counter with a value less than seven.

Bayardo teaches the method of claim 21, wherein at least one removed conflict clause comprises an activity counter with a value less than seven (**Bayardo**; page 204,

Art Unit: 2129

C2, L15-31; gathering the variables within 20% of the best score, which could be less than seven).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating at least one removed conflict clause comprises an activity counter with a value less than sixty as taught by Bayardo for the purpose of maintaining only the variables that occur more frequently in a clause.

As per claim 24, Marques-Silva teaches the one or more unsatisfied conflict clauses removed from the structure do not include the clause at the top of the structure (Page, 511, Fig 2; the examiner reads that during the backtracking phase, the top conflict is never removed because the search process backtracks to the preceding level "B-1 ").

As per claim 25, Marques-Silva does not teach no less than a specified percentage of the conflicts in the structure are removed.

Bayardo teaches he method of claim 16, wherein no less than a specified percentage of the conflicts in the structure are removed (**Bayardo**; page 204, C2, L15-31).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the teachings of Marques-Silva by incorporating no less than a specified percentage of the conflicts in the structure are removed as taught by

Art Unit: 2129

Bayardo for the purpose of removing the necessary conflicts in the structure to obtain a satisfactory result

As per claim 26, Marques-Silva teaches the top conflict clause of the structure is never removed (Page, 511, Fig 2; the examiner reads that during the backtracking phase, the top conflict is never removed because the search process backtracks to the preceding level "B-1").

As per claim 27, Marques-Silva teaches a) invoking reverse Boolean Constraint Propagation when a conflict arises; b) deducing a new conflict clause (Section 2.5, Number 2, Page 509); c) returning the answer "no solution" if this clause is empty or adding the newly deduced conflict clause to the top of the structure otherwise (The examiner reads Figure 2 as code that describes the steps presented above. The examiner reads the steps described above as "backtracking"; which is described on page 510, section 3.1.2).

As per claim 28, Marques-Silva teaches a conflict arises when all literals in one of the plurality of clauses are set to 0 as a result of one or more assignments of value (Fig. 2; the examiner reads that the free literals in the clause can be set to zero as a result of the assignments of value. The literals are either set to zero, or the complement).

As per claim 29, Marques-Silva teaches back tracking is nonchronological (Page 511; the examiner reads the search process back tracks non-chronologically by jumping back over several levels).

As per claim 30, Marques- Silva teaches starting a new search tree when more than a threshold number of conflict clauses have been deduced or more than a threshold number of unit conflict clauses have been deduced (Looking at Figure 2, If a conflict arises, the erase function gets called, and the process starts over again, therefore a new search has been invoked on a new tree).

As per claims 51, 52 and 53, Marques-Silva teaches the structure comprises either a stack or a queue (The Examiner considers that the clause database can be configured to behave as either a stack or a queue).

9. Claims 54-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Marques-Silva in view of Bayardo as set forth above and further in view of Biere et al. ("Symbolic Model Checking Using SAT Procedures Instead of BDD's", referred to as **Biere**).

As per claims 54-56, Marques-Silva and Bayardo do not teach the solution is applied for a circuit design undergoing synthesis, test pattern generation or verification.

Biere teaches the solution is applied for a circuit design undergoing synthesis, test pattern generation or verification (**Biere**: page 317, abstract; pages 318-319, Sections 3 and 4.1).

It would have been obvious to one of ordinary skill in the arts at the time of the applicant's invention to modify the combined teachings of Marques-Silva and Bayardo by incorporating applying the solution to a circuit design undergoing synthesis, test pattern generation or verification as taught by Biere for the purpose of taking advantage of the efficiency of the of the algorithm in handling Boolean expressions to detect errors in the circuit model since most of these models are described using Boolean expressions (**Biere**: page 317, Introduction, L1-17).

### Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

Art Unit: 2129

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

***Correspondence Information***

11. Any inquires concerning this communication or earlier communications from the examiner should be directed to Omar F. Fernández Rivas, who may be reached Monday through Friday, between 8:00 a.m. and 5:00 p.m. EST. or via telephone at (571) 272-2589 or email [omar.fernandez.rivas@uspto.gov](mailto:omar.fernandez.rivas@uspto.gov).

If you need to send an Official facsimile transmission, please send it to (571) 273-8300.

If attempts to reach the examiner are unsuccessful the Examiner's Supervisor, David Vincent, may be reached at (571) 272-3080.

Hand-delivered responses should be delivered to the Receptionist @ (Customer Service Window Randolph Building 401 Dulany Street Alexandria, VA 22313), located on the first floor of the south side of the Randolph Building.

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Wednesday, December 20, 2006

  
12/20/06  
DAVID VINCENT  
SUPERVISORY PATENT EXAMINER

OFR